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Estimation of genetic diversity in fenugreek (*Trigonella foenum graecum* L.) genotypes for productivity traits

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Abstract

A field experiment was undertaken during the year 2016-2017 in *rabi* season at Kittur Rani Channamma College of Horticulture, Arabhavi to study the extent of genetic diversity existing in fenugreek genotypes. The experiment was laid out in randomized block designs with two replications. A total of 34 fenugreek genotypes were used in the present study. Mahalanobis D^2 analysis indicated considerable diversity and 34 genotypes were grouped into three different clusters. The cluster I showed maximum (241.03) intra cluster distance. Inter cluster distance revealed the maximum divergence between clusters III and cluster II ($D^2 = 3067.42$) followed by cluster III and cluster I ($D^2 = 1905.37$). Among all the 26 productivity traits studied, 100 seed weight, seed yield per plot, days to fruit maturity, pod weight, pod number, pod length and seed yield per plant contributed greatly towards divergence. These traits may given more importance in selecting the genotypes. The genotype Kasuri methi in cluster II recorded highest cluster mean. This genotype can be used as a base material for future breeding programme.

Keywords: fenugreek (*Trigonella foenum graecum* L.), genetic diversity, genotype Kasuri methi

Introduction

Fenugreek (*Trigonella foenum graecum* L.) is an annual herb belongs to Leguminosae family. It is a small seeded and self pollinated, diploid annual legume plant with chromosome number $2n = 16$, grown as multipurpose crop. It is considered to have originated in the Mediterranean Region of the "Old World" (Vavilo, 1926) or in part of Asia (De Candolle, 1964). The spice name "*Trigonella foenum*" means "Greek hay" indicating its use as a forage crop in the past. Fenugreek is widely cultivated in warm temperate and tropical region of the Mediterranean, Europe and Asia. An important non spice use of fenugreek is as a potential source of diosgenin. It is also known as one of the oldest medicinal plant recognized historically. The seeds of matured crop are used as spice for flavouring almost all dishes and as condiment. The leaves both fresh and dried are used in meat curries and several vegetable dishes. In India its cultivation is concentrated mainly in Rajasthan, which has share of 83 per cent of the total fenugreek production in the country (Anon., 2013). In India, during 2017-18 fenugreek was cultivated in an area of 220 thousand hectares with production of 311 thousand MT and productivity of 1.4 MT (Anon., 2018). To formulate a sound and successful breeding programme, the importance of genetic variability in the population needs emphasis. To make an improvement in any crop species, the breeder is constantly engaged in effective choice of desirable parents of high genetic variation so that individuals with desirable character combination can be selected. Genetically diverse parents are likely to produce high genetic diversity effects and desirable traits tool in quantifying the degree of divergence among the biological populations.

Material and Methods

The present study was carried out at Kittur Rani Channamma, College of Horticulture, Arabhavi during *Kharif* season in 2016-17 with 34 fenugreek genotypes. The genotypes were assessed in a field experiment under a Randomized Block Design with two replications. Cultural practices including need based plant protection measures were followed as per the recommendations. The data were recorded on five randomly selected plants from each genotype for 34 traits. Observations were recorded on plant height at 30, 45 and 60 DAS, plant

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girth at 30, 45 and 60 DAS, number of branches at 30, 45 and 60 DAS, EW plant spread at 30, 45 and 60 DAS, NS plant spread at 30, 45 and 60 DAS, leaf area at 30 and 60 DAS, days to first flowering, days to 50 per cent flowering, days to fruit maturity, pod weight, pod number, pod length, 100 seed weight, seed yield per plant and seed yield per plot. Mahalonobis (1936) D^2 statistics was used for assessing the genetic divergence between 34 fenugreek genotypes. A generalized distance (D^2) was calculated for each pair of genotypes. The D^2 values were obtained as the sum of squares of difference between two pairs of corresponding uncorrected values of any two genotypes [3]. Using all D^2 values, the genotypes were grouped into clusters using Tocher's method as described by [3]. The intra and inter-cluster distances were calculated by the formula given by [4].

Result and Discussion

The analysis of variance has revealed highly significant differences between genotypes in respect of all characters, suggesting considerable divergence between them. 34 genotypes were grouped into three clusters by treating estimated D^2 values as the squares of generalized distances. Cluster I was the largest cluster comprising of thirty two genotypes, followed by cluster II and Cluster III consisted of one genotype (Table 2).

The selection and choice of parents mainly depends on contribution of characters towards divergence. In the present study (Table 1), Hundred seed weight contributed maximum (47.06%) to the total diversity followed by seed yield per plot (34.76%), days to fruit maturity (5.88%), pod weight (4.80%), pod number and pod length (1.96%), seed yield per plant (1.43%), NS plant spread at 60 DAS (0.53%), plant height at 30 DAS and days to 50 per cent flowering (0.36% each) and number of branches at 60 DAS, EW plant spread at 30 and 45 DAS, leaf area at 60 DAS and days to first flowering (0.18% each). The remaining all other traits did not contributed to the total diversity [5-9].

All genotypes spread over three clusters and means were scored across the clusters for all the twenty six characters. The highest cluster mean was given the first rank and next clusters possessing next best means were given second, and third rank for all the traits except days to first flowering, days to fifty per cent flowering and days to fruit maturity, where lowest values were given first rank and highest values was last rank. Accordingly, cluster III with overall score of 47 across 26 characters secured first rank followed by clusters I and II indicating presence of most promising genotypes in

them and can be extensively used for further breeding programme to generate new material.

Average intra and inter cluster distance for 34 fenugreek genotypes were presented in the table 3. Cluster I, which contains eight genotypes exhibited maximum intra cluster distance ($D^2 = 241.03$) whereas cluster II and III exhibited zero distance as they possess single genotype. Inter-cluster distances depict that clusters III and cluster II had maximum divergence ($D^2 = 3067.42$) among them, followed by cluster III and cluster I ($D^2 = 1905.37$). The least inter-cluster distance was observed between cluster II and cluster I ($D^2 = 1808.31$). The diverse genotypes characterized by maximum inter cluster distance will differ in phenotypic performance and therefore, selection of divergent parents should be based on these cluster distances to obtain favorable hybrids and transgressive segregants in fenugreek.

Table 1: Per cent contribution of different characters towards divergence in fenugreek genotypes

S. No.	Characters	Times ranked 1 st	Percent Contribution
1	100 seed weight	264	47.06
2	Seed yield per plot	195	34.76
3	Days to fruit maturity	33	5.88
4	Pod weight	27	4.80
5	Pod number	11	1.96
6	Pod length	11	1.96
7	Seed yield per plant	8	1.43
8	NS plant spread at 60 DAS	3	0.53
9	Plant height at 30 DAS	2	0.36
10	Days to 50 per cent flowering	2	0.36
11	Number of branches at 60 DAS	1	0.18
12	EW plant spread at 30 DAS	1	0.18
13	EW plant spread at 45 DAS	1	0.18
14	Leaf area at 60 DAS	1	0.18
15	Days to first flowering	1	0.18
16	Plant height at 45 DAS	-	0
17	Plant height at 60 DAS	-	0
18	Plant girth at 30 DAS	-	0
19	Plant girth at 45 DAS	-	0
20	Plant girth at 60 DAS	-	0
21	Number of branches at 30 DAS	-	0
22	Number of branches at 45 DAS	-	0
23	EW plant spread at 60 DAS	-	0
24	NS plant spread at 30 DAS	-	0
25	NS plant spread at 45 DAS	-	0
26	Leaf area at 30 DAS	-	0

Table 2: Clustering pattern of 34 fenugreek genotypes

Cluster number	No. of genotypes	Genotype name
Cluster I	32	L-17, Ghataprabha local, Gujarat, Rmt-305, L-9, L-13, L-16, L-21, Pant Ragini, DFnc-11, DFnc-12, L-14, L-15, Gokak local, AFG-1, Johar, DFnc-6, DFnc-13, Rmt-143, Rmt-351, Rmt-365, Pusa early bunch, L-20, LS1, Mritunjaya S C, DFnc-7, DFnc-8, DFnc-9, DFnc-10, Rmt-1, Rmt-303 and Rmt-361
Cluster II	1	Kasuri methi
Cluster III	1	Rmt-354

Table 3: Average intra and inter cluster distances for 34 fenugreek genotypes

Clusters	Cluster I	Cluster II	Cluster III
Cluster I	241.03	1808.31	1905.37
Cluster II		0.00	3067.42
Cluster III			0.00

- Diagonal values indicate intra cluster distance
- Above diagonal values indicate inter cluster distance.

Table 4: Cluster means for 26 traits from D² analysis and their rankings

S. No.	Character	Ranking	Cluster I	Cluster II	Cluster III
1	Plant height at 30 DAS		9.19	8.61	1.97
		R	1	2	3
2	Plant height at 45 DAS		22.60	20.97	30.31
		R	2	3	1
3	Plant height at 60 DAS		39.27	43.66	45.16
		R	3	2	1
4	Plant girth at 30 DAS		1.82	1.69	2.21
		R	2	3	1
5	Plant girth at 45 DAS		2.79	2.91	2.65
		R	2	1	3
6	Plant girth at 60 DAS		4.23	4.00	4.92
		R	2	3	1
7	Number of branches at 30 DAS		2.09	1.30	2.10
		R	2	3	1
8	Number of branches at 45 DAS		5.28	4.50	5.20
		R	1	3	2
9	Number of branches at 60 DAS		8.80	8.10	7.90
		R	1	2	3
10	EW plant spread at 30 DAS		5.11	5.55	5.26
		R	3	1	2
11	EW plant spread at 45 DAS		8.38	14.93	8.18
		R	2	1	3
12	EW plant spread at 60 DAS		12.03	17.83	10.28
		R	2	1	3
13	NS plant spread at 30 DAS		4.89	5.44	5.18
		R	3	1	2
14	NS plant spread at 45 DAS		8.19	10.42	15.33
		R	3	2	1
15	NS plant spread at 60 DAS		12.94	12.33	12.34
		R	1	3	2
16	Leaf area at 30 DAS		18.69	18.69	19.52
		R	2	2	1
17	Leaf area at 60 DAS		51.18	53.04	59.53
		R	3	2	1
18	Days to first flowering		39.03	39.00	63.50
		R	2	1	3
19	Days to 50 per cent flowering		47.58	47.00	81.00
		R	2	1	3
20	Days to fruit maturity		76.30	81.00	115.00
		R	1	2	3
21	Pod number		10.34	35.30	10.40
		R	3	1	2
22	Pod weight		10.06	2.36	10.46
		R	2	3	1
23	Pod weight		1.51	1.02	2.10
		R	2	3	1
24	Seed yield per plant		0.96	0.67	1.11
		R	2	3	1
25	100 seed weight		0.99	0.13	1.02
		R	2	3	1
26	Seed yield per plot		40.48	23.40	73.60
		R	2	3	1
	Overall score		53	55	47
		R	2	3	1

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